NASAfacts

SARDA

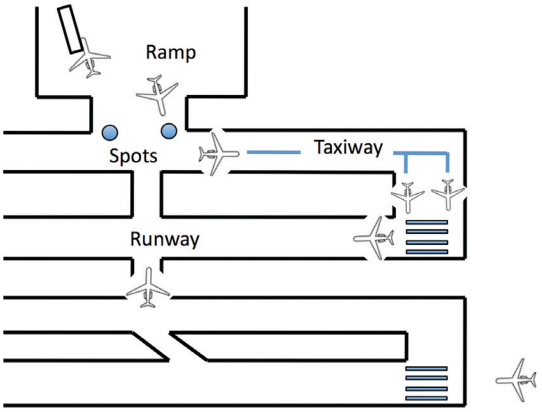
Spot and Runway Departure Advisor

What is the problem?

In today's airport surface operations, the management of surface traffic is distributed amongst many different operators. Airline ramp controllers direct the push back of aircraft from the gate when they are ready for departure to the ramp area surrounding the gates, then to designated "spots," where aircraft wait for a taxi clearance by airport tower Ground Controllers before proceeding onto the taxiway. Ground Controllers release aircraft from these spots as soon as they are ready to taxi. Once aircraft reach the entrance to the runway, Local Controllers schedule the aircraft departure times on a first-come-first-served basis, rather than in an ideal order based on aircraft characteristics, separation criteria, and expected departure times. Aircraft that are unable to depart immediately are held in one or more queues until they can be cleared for departure. Each of these airport operators also deals with a piece of the overall schedule, and the scheduling information is not easily shared between the operators.

While distributing the management of surface traffic to multiple operators helps to parcel out the workload, the lack of coordination and shared, accurate schedule information can easily lead to surface traffic congestion along the taxiways and in the departure queues, especially during periods of heavy traffic. Aircraft may be required to stop multiple times as they proceed along the taxiway due to the presence of other departing traffic ahead or to allow for crossing arrival traffic. Without advanced decision support tools, controllers must resort to dealing with the congestion tactically, which is less efficient.

Stop-and-go aircraft operations along a congested airport's surface requires added engine power and fuel burn, which adversely affects the environment. Recent studies of surface traffic data from Dallas/Fort Worth International Airport (DFW) revealed that as much as 18% of fuel consumption during taxi operations was due to stop-and-go activity. If this stop-and-go activity can be eliminated by improving the efficiency of taxi operations, it would result in 2.5 million gallons of jet fuel savings per year.

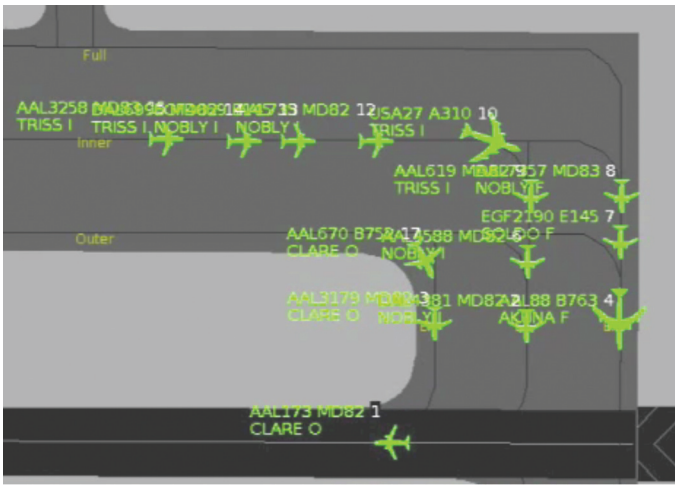


The Spot and Runway Departure Advisor (SARDA) helps to improve the efficiency of airport surface operations involving the ramps, spots, taxiways, and runways.

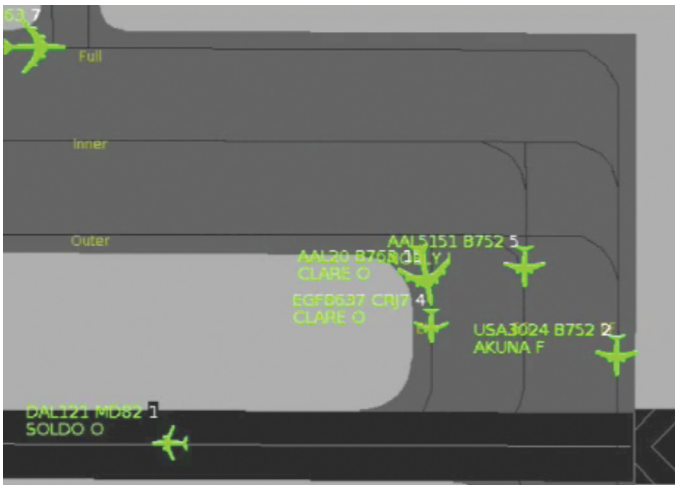
What is NASA's solution?

Improving the efficiency of airport surface operations is the focus of NASA's surface optimization research. NASA is currently researching shortening the amount of time an aircraft spends taxiing before takeoff to alleviate some of the congestion on the airport surface. Reduced taxi times will help to eliminate unnecessary fuel burn, resulting in fewer emissions and less impact on the environment. NASA is also developing the decision support tools that tower controllers will need to manage more efficient operations.

NASA's ***Spot and Runway Departure Advisor (SARDA)*** is being designed to help tower controllers: maintain a smooth, uninterrupted flow of aircraft moving towards the runway for departure to maximize runway throughput; keep the departure queue at a minimum; and reduce runway crossing wait times. For Ground Controllers, SARDA creates an optimal schedule for releasing aircraft from spots into the taxiway. It



This image shows SARDA simulation baseline conditions, where no advisories were provided to controllers. Because the Ground Controllers tend to release aircraft from the ramp area to the taxiway without considering the level of congestion, significant queues build up near the departure runway, causing extra fuel consumption and excessive engine emissions.



This image shows simulation conditions for the same scenario as seen at left, but with controller advisories. During SARDA experiments, controllers were able to achieve the same throughput without causing congestion on taxiway and runway queue areas.

provides sequence and timing advisories that minimize the buildup of traffic in the taxiway or runway queue, while still maintaining maximum throughput. Departing aircraft can therefore remain in the ramp area with engines off until just before their scheduled spot departure time, and when advised, they can proceed straight to the runway without stopping for other traffic, thus significantly reducing fuel burn and environmental emissions.

SARDA also helps Local Controllers carry out more efficient runway operations in managing arrival traffic. Frequently, after landing, arrival aircraft must wait to cross active departure runways to get to their assigned gates. Taking into account factors such as required separation and expected departure times, SARDA provides optimized take-off advisories for departure aircraft, and runway crossing sequence advisories for arrival aircraft.

In 2010, NASA completed real-time, human-in-the-loop simulations using NASA Ames Research Center's FutureFlight Central facility to study the performance of the SARDA system. Multiple test scenarios, including normal and heavy traffic levels, were created for the simulations based on actual DFW surface traffic data. Experienced DFW controllers participated in the experiment and provided NASA researchers with valuable data concerning workload and situation awareness. System performance data, including taxi times and delay, number of stops, departure queue size, fuel consumption, and emissions, were also collected. Initial results show that the average taxi time delay per departure aircraft in the movement area (the taxiways and runways) was reduced by 66% and the average fuel consumption per departure aircraft in the movement area was reduced by 38%. These preliminary results indicate a significant improvement in overall airport surface efficiency using SARDA.

Additional simulation evaluations are planned to investigate how to increase the SARDA system's robustness and improve its user interfaces. In addition, SARDA has been identified as a potential candidate for technology transfer to the Federal Aviation Administration through the inter-Agency Research Transition Team, which will enable a smooth handover of NASA-developed air traffic management research advances targeted for the operational environment.

For more information on the Spot and Runway Departure Advisor (SARDA), please visit **www.aviationsystems.arc.nasa.gov.**

National Aeronautics and Space Administration

Ames Research Center
Moffett Field, CA 94035
www.aviationsystems.arc.nasa.gov

www.nasa.gov

FS-2010-12-01-ARC